United States Patent

Sato et al.

[15] **3,637,329**

[45] **Jan. 25, 1972**

[54] **PUMP**

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May 29, 1969 Japan.....44/41940

[52] **U.S. Cl.**.....**417/360,** 417/368, 417/423

[51] **Int. Cl.**.....**F04b 17/00,** F04b 35/00

[58] **Field of Search**.....417/423, 424, 368, 370, 360

[56] **References Cited**

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[57] **ABSTRACT**

A canned motor pump has a stator sealed from a rotor, the rotor driving a shaft that carries an impeller. The shaft rotates in front and rear bearings while the thrust of the impeller is balanced by fluid passing through an orifice plate behind the impeller. A front bearing housing is separate from but interconnected with the orifice plate by an adapter. The stator may be externally heat exchange jacketed, while a guide disc may be carried by the front bearing housing to direct fluid radially inwardly toward the intake of an auxiliary impeller.

3 Claims, 5 Drawing Figures

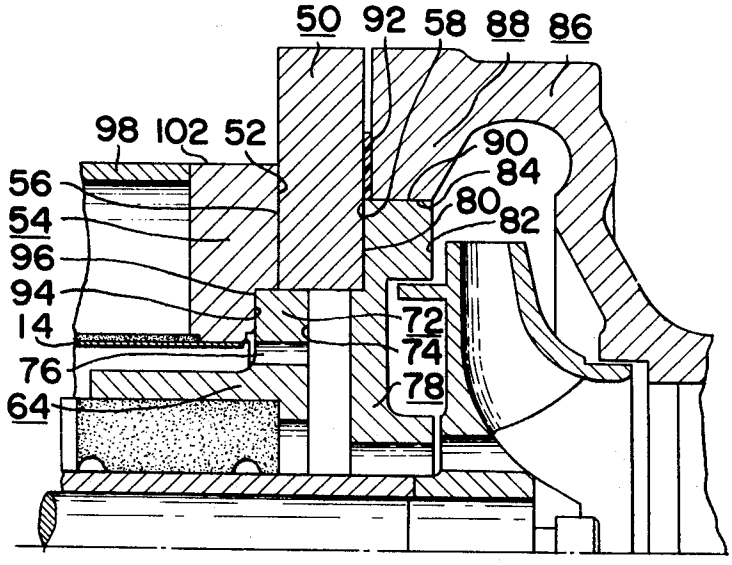

FIG. 1
(PRIOR ART)

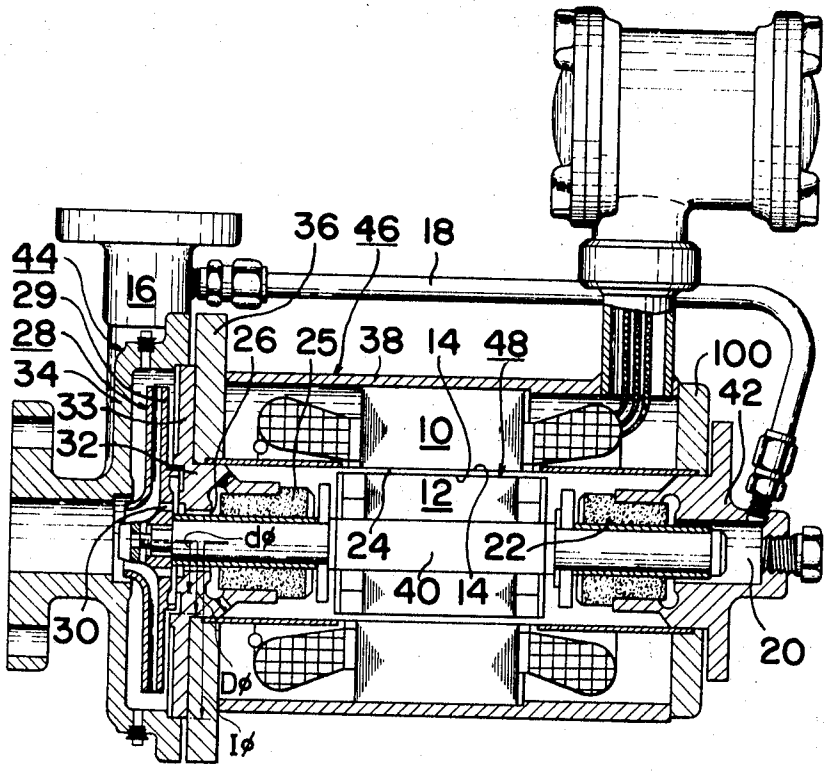

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FIG. 2

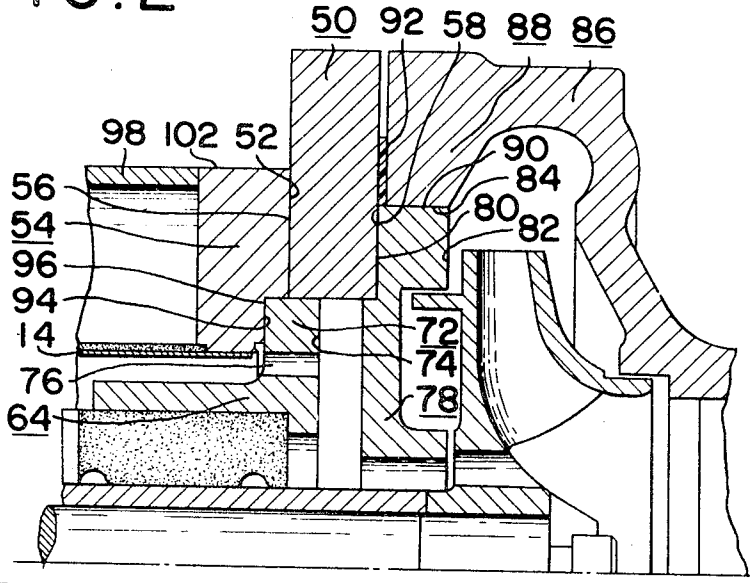

FIG. 5

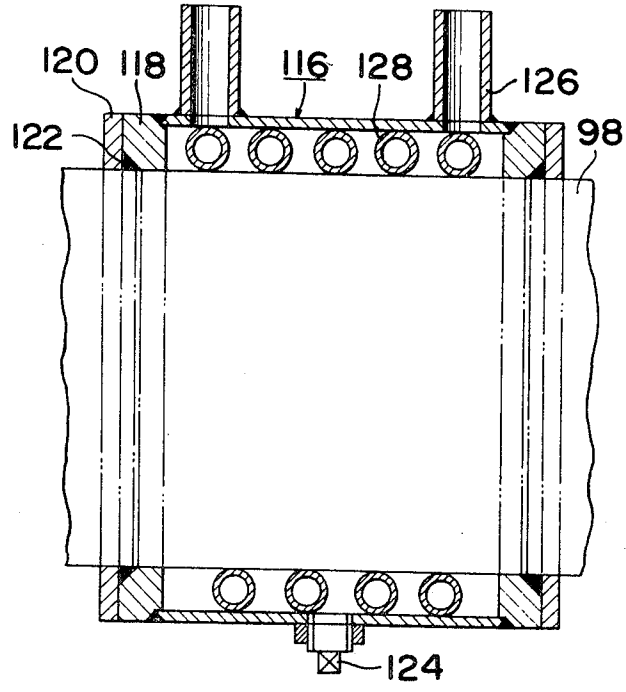

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FIG. 3

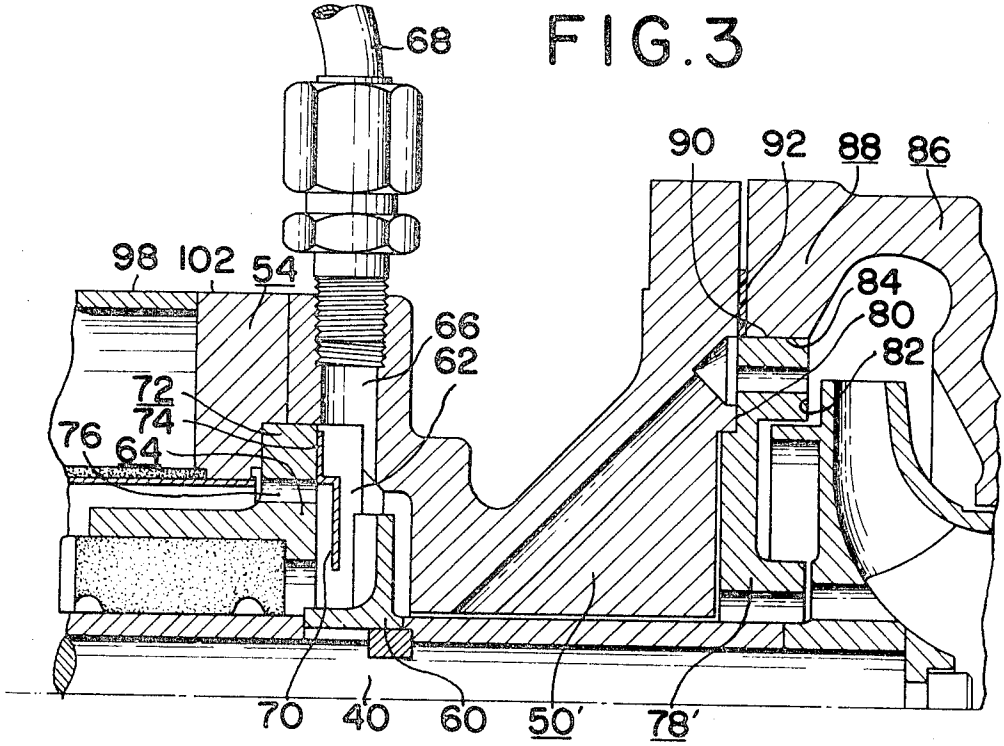
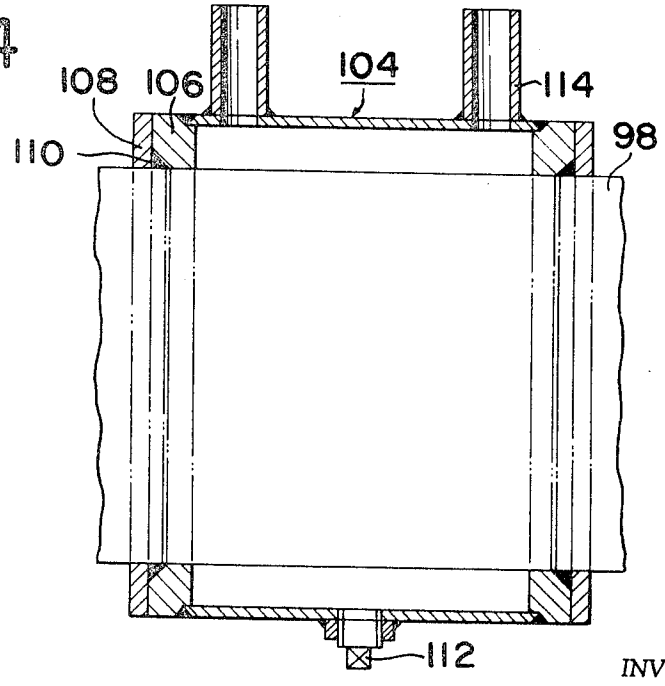


FIG. 4



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PUMP

The present invention relates to canned motor pumps of the type driven by an electric motor having the stator and rotor sealed from each other by a sheet of nonmagnetic metal such as stainless steel. A portion of the liquid from the pump delivery is returned to the rotor chamber and passes between the rotor and the stator and through the front bearing of the rotor shaft and thence through balancing orifices to the rear of the impeller mounted on the shaft.

Known pumps of this type mount the front shaft bearing in a bearing housing which also provides a rear wall for the impeller chamber, the balancing orifices passing through this same member. However, this construction has been found to be disadvantageous, because various motor assemblies may require variations in this member disposed between the impeller chamber and the motor chambers. Also, on the other hand, variations in the impeller and its operating characteristics may require variations in the arrangement of the balancing orifices; so that again, it is necessary to provide a number of different types of members separating the impeller and motor chambers, for use under various conditions having to do with the impeller. It frequently happens, for example, that the dimensions $d\phi$, $D\phi$ and $I\phi$ must be varied, as indicated in FIG. 1 of the accompanying drawings.

Accordingly, it is an object of the present invention to provide a canned motor pump, in which different requirements with respect to the front shaft bearing and/or the impeller chamber may be quickly and easily satisfied with a minimum of different parts.

Another object of the present invention is the provision of such a pump, which will be relatively simple and inexpensive to manufacture, easy to install, adjust, maintain, operate and repair, and rugged and durable in use.

Briefly, the present invention achieves these objects by providing a front bearing housing which is separate from an orifice plate behind the impeller, and by interconnecting these two members by means of an adapter.

Optionally, the stator can be heat exchange jacketed. Also optionally, an auxiliary impeller can be carried by the rotor shaft for circulation of the pumped liquid through the rotor chamber, with the front bearing housing carrying a guide disc that deflects liquid to the central intake portion of the auxiliary impeller.

Other objects, features and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a view in longitudinal cross section of a pump of the general type of the present invention, but constructed according to the prior art;

FIG. 2 is an enlarged fragmentary view, from the side opposite the side shown in FIG. 1, of a pump according to the present invention in the vicinity of the front shaft bearing and impeller thereof;

FIG. 3 is a view similar to FIG. 2, but showing another embodiment of pump according to the present invention, for use in high-temperature applications;

FIG. 4 is a fragmentary cross-sectional view of one embodiment of heat exchange jacket disposed about the stator of the motor shown in FIGS. 2 and 3; and

FIG. 5 is a view similar to FIG. 4 but showing another embodiment of heat exchange jacket.

Referring now to the drawings in greater detail, and first by way of background to the prior art construction shown in FIG. 1, there is shown a canned motor pump of known type in which a stator **10** surrounds a rotor **12** with a sheet of nonmagnetic metal such as stainless steel sealing the rotor chamber from the stator chamber. A portion of the pumped liquid is removed from the pump outlet **16** through a conduit **18** and recirculated to a chamber **20** rearwardly of the rotor, the liquid then passing through a flow channel in the rear bearing **22**, through the clearance **24** between rotor **12** and stator **10**, through the front bearing **25**, through orifices **26** that extend along the shaft, and thence to the rear of the impeller **28** where the liquid passes through symmetrically arranged openings **30** to be pumped again by the impeller.

The front bearing **25** is carried by a front bearing housing **32** that has a radially outwardly extending portion **33** that forms a rear wall for the impeller chamber. The orifices **26** pass through the radially inner portion of housing **32**.

The pump casing is shown at **34**, a closure plate at **36**, and a stator housing at **38**. The rotor shaft is designated **40**, while the rear bearing housing is shown at **42**. The pump assembly is indicated generally at **44**, the stator assembly generally at **46**, and the rotor assembly generally at **48**.

Turning now to FIG. 2, a first embodiment of the present invention is shown. Briefly stated, the member **32** of FIG. **1** has been replaced by three members comprising a separate front bearing housing for the shaft, a separate orifice plate for directing fluid to the rear side of the impeller, and an adapter to interconnect the front bearing housing and the orifice plate. The front bearing housing can be changed according to the varying motor and shaft requirements, mentioned above. The orifice plate can be selected according to the varying pump requirements, mentioned above.

With more particular reference to FIG. **2**, there is shown an adapter **50** in the form of an annular member having one end face **52** that abuts end closure plate **54** of the stator housing and whose forward end face **56** in turn lies flat against end face **52** of adapter **50**. The forward end face **58** of adapter **50** abuts the pump assembly in a manner to be explained. The motor assembly and pump assembly and adapter **50** are interconnected by conventional detachable fastening means (not shown).

FIG. **3** differs from FIG. **2** in that the structure of FIG. **3** is especially adapted for high temperature operation. The structure shown in FIG. **3** includes an auxiliary impeller **60** secured to the rotor shaft **40** and disposed in an auxiliary pump chamber **62** formed between the adapter **50'** and the front bearing housing **64**. Auxiliary impeller **60** thus circulates liquid from the auxiliary chamber **62** through a delivery connection **66** and thence through a circulation conduit **68** to the rear of the rotor chamber, in the manner indicated in FIG. **1**, thereby to provide a recirculation system that is independent of the main impeller circulation.

As is also shown in FIG. **3**, an annular guide disc **70** is secured to the forward peripheral surface **74** of edge portion **72** of front bearing housing **64**. Recirculating liquid passes through the orifices **76** through housing **64**, moving to the right as seen in FIG. **3**, and is deflected by guide disc **70** to the radially inner portion of auxiliary impeller **60**, which is the intake portion or suction side of impeller **60**, thereby to improve the circulation of the liquid.

The novel combination of the present invention also includes an orifice disc **78** (FIG. **2**) or **78'** (FIG. **3**) having a rear face which abuts the adapter **50** or **50'**, while a forward end face **82** coacts with the impeller to balance the axial thrust of the impeller. It should be particularly noted that this orifice disc is separate from the front bearing housing and is spaced therefrom by the adapter.

Although an outer periphery **84** of the orifice disc is shown in engagement with an inner periphery **90** of an end portion **88** of the pump casing **86**, the orifice disc may be secured to the adapter **50** only, or the end face **80** of the disc **78** may be of an enlarged size and may be engaged with an end face **92** of the pump casing **86**.

An end face **94** of the front bearing housing **64** is joined with a recessed end **96** of the front end closure plate **54** and clamped by suitable conventional detachable fastening means (not shown). Alternatively, the edge portion **72** of the bearing housing may be extended so that the end face **94** may be faced with the whole end face area of the end closure plate **54**.

The end closure plate **54** forms with a stator housing member **98** and the sheet **14** and a rear end closure plate **100** (FIG. **1**) a chamber for the stator assembly. This front end closure plate **54** is secured to the bearing housing **64** and the adapter **50** or **50'**, or alternatively only with the housing **64** in

which case the edge portion **72** of housing **64** is radially extended so that the end face **94** confronts the whole end face area of the end closure plate **54**. The outer periphery **102** of end closure plate **54** is in alignment with the outer periphery of housing member **98**, which makes for ease of assembling and disassembling the parts.

The liquid circulating in the rotor housing not only lubricates the bearings but also absorbs the heat of the motor. To cool this liquid, a jacket assembly or jacket-type heat exchange assembly is disposed about the outer periphery of the stator housing, as seen in FIGS. **4** and **5**. In the FIG. **4** embodiment, a jacket assembly **104** is comprised of a jacket body **106**, a cover plate **108**, a gasket **110**, a plug **112**, and an inlet **114** for fluid heat exchange medium. In the FIG. **5** embodiment, the jacket-type heat exchange assembly **116** is comprised of a jacket body **118**, a cover plate **120**, a gasket **122**, a plug **124**, an inlet **126**, and circulation tubing **128** for a portion of the heat exchange fluid. The inner diameters of jacket bodies **106** and **118** are preferably the same as the outer diameter of the stator housing member **98** so that the heat exchange jackets can be easily mounted on the stator housing.

From a consideration of the foregoing disclosure, therefore, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

Having described our invention, we claim:

1. A canned motor pump comprising a pump casing having an inlet and an outlet, an impeller disposed in the pump casing and mounted on a shaft, an electric motor comprising a stator, a rotor within the stator and mounted on said shaft, a plurality of bearings for said shaft spaced along said shaft, one of said bearings being nearest said impeller, a bearing housing in which said one bearing is mounted, an orifice disc disposed behind the impeller and having orifices therethrough for conveying fluid to the rear of the impeller to balance the thrust of the impeller, and an adapter disposed between and removably secured to said bearing housing and said orifice disc whereby said bearing housing and adapter and orifice disc are removably secured to each other.

2. A pump as claimed in claim **1**, and an auxiliary impeller on the shaft adjacent said bearing housing, said bearing housing having openings therethrough for the transmission of fluid toward said auxiliary impeller, and an annular guide disc on said bearing housing between said bearing housing and said auxiliary impeller for deflecting fluid passing through said openings in a direction radially inwardly of said auxiliary impeller, and means to transmit fluid from said auxiliary impeller to the rear of said shaft.

3. A canned motor pump as claimed in claim **1**, and a heat exchange jacket surrounding said stator, and means to supply a fluid to the interior of said heat exchange jacket.

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